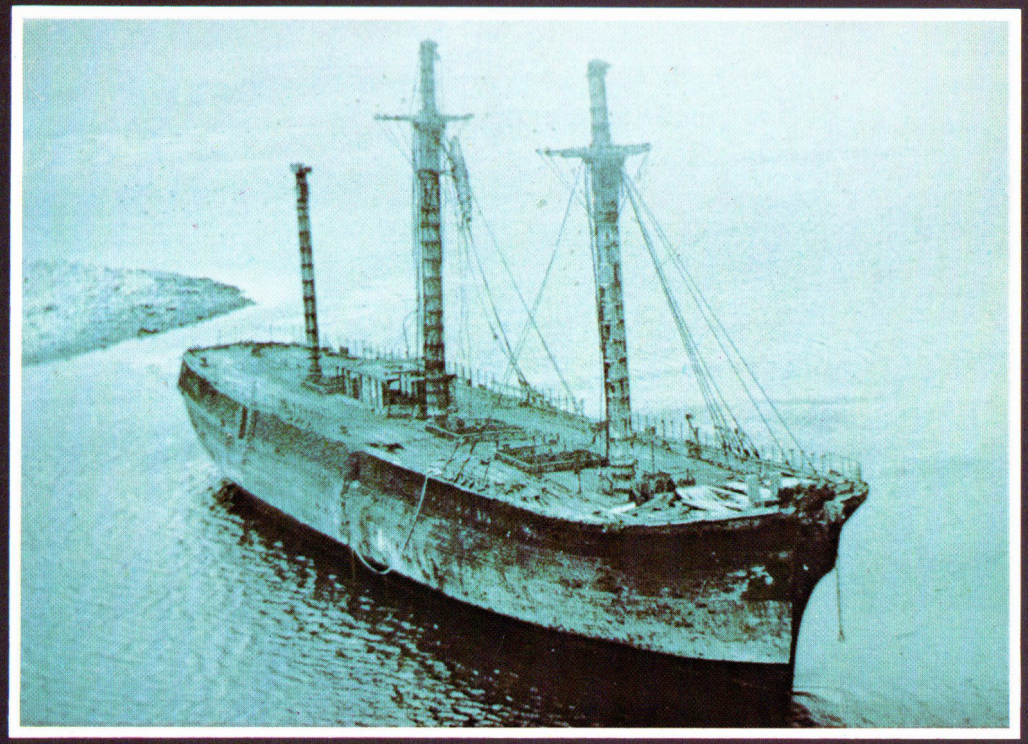
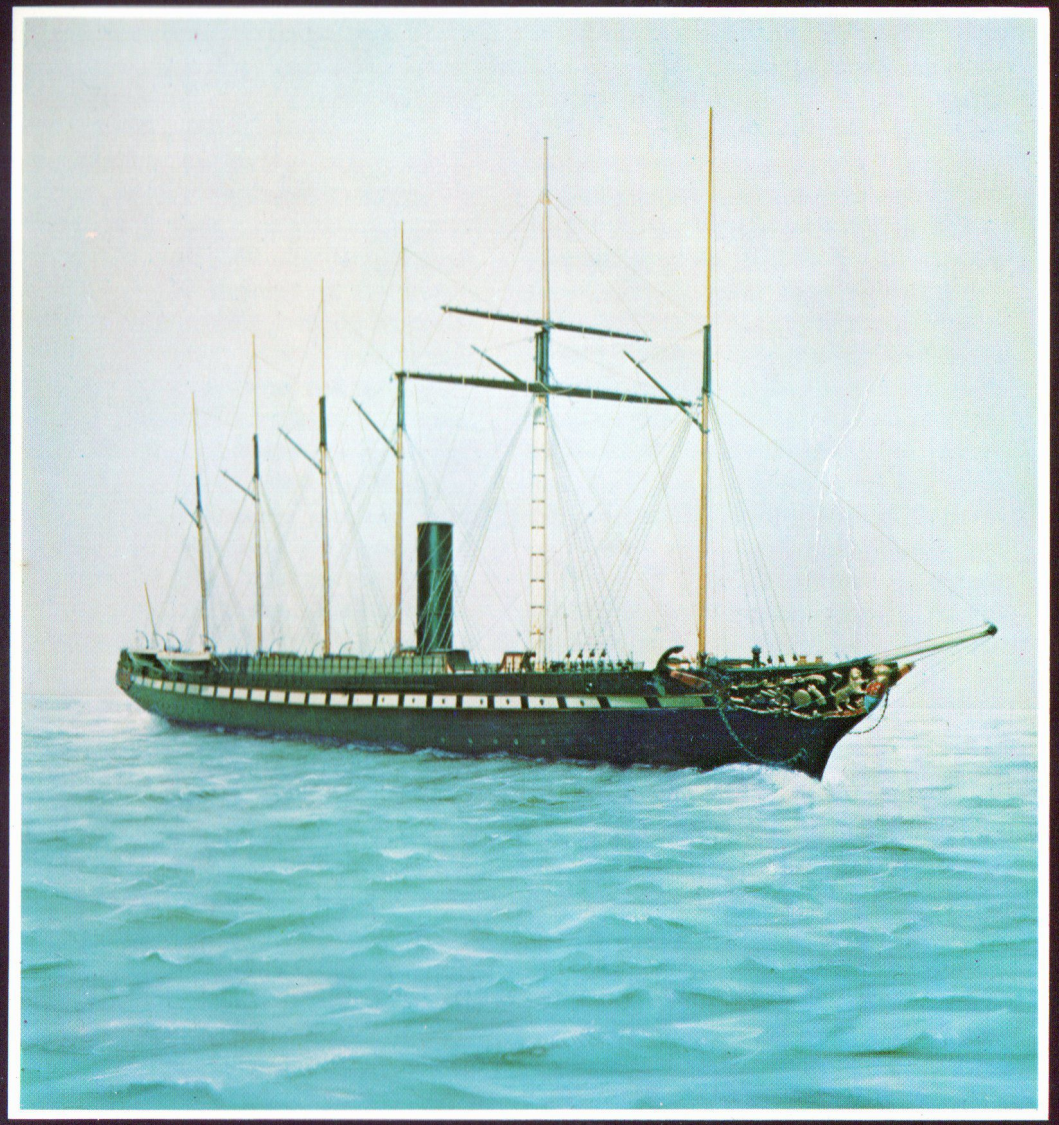


S.S. Great Britain



Concept & Design

When the *Great Britain* was launched on July 19th, 1843, she was far larger than any other ship afloat and was revolutionary in many aspects of her design. Why was this? What commercial or technical reasons were there for the construction of such a ship, many of whose features were to set new standards for all later ship-building?

The *Great Britain* represented a bold attempt by a British company to compete on a totally fresh basis in the North Atlantic passenger trade, where the United States had held a near monopoly for thirty years. With fast sailing packets of 300 to 500 tons the Americans provided a reliable service on regular dates, and this was just what was required by the merchants and shippers of New York and Liverpool. For this regularity, too, the first-class passengers themselves were prepared to accept indifferent conditions, while below them in the poorer accommodation travelled emigrants from Europe—the beginnings of the stream which later in the century would eventually swell to the flood that filled the continent of North America.

The United States' virtual domination of the transatlantic trade continued until the Great Western Steamship Company of Bristol, inspired by its chief engineer, Isambard Kingdom Brunel, decided to try to out-build the Americans with larger ships and by using the new development of steam. With his first ship, the *Great Western*, launched in 1837 and of 1,320 gross registered tons, Brunel proved that it was possible for a steam ship with paddle wheels to make regular voyages back and forth across the Atlantic without running out of coal. And her speed, reliability and comfort quickly eclipsed the sailing packets.

As confidence in the *Great Western* grew, so did Brunel's ambition. His next step would be to build a sister ship, rather better and faster as a result of the lessons learned with the first one, though she would still be constructed of wood and driven by paddles. She would be called the *City of New York*.

This was not, however, quite how events turned out. As the design work proceeded, the proposed new vessel gradually got bigger. It had after all been one of Brunel's most historic contributions to marine engineering to announce his categoric support for the view, hotly disputed at the time, but quite correct that:

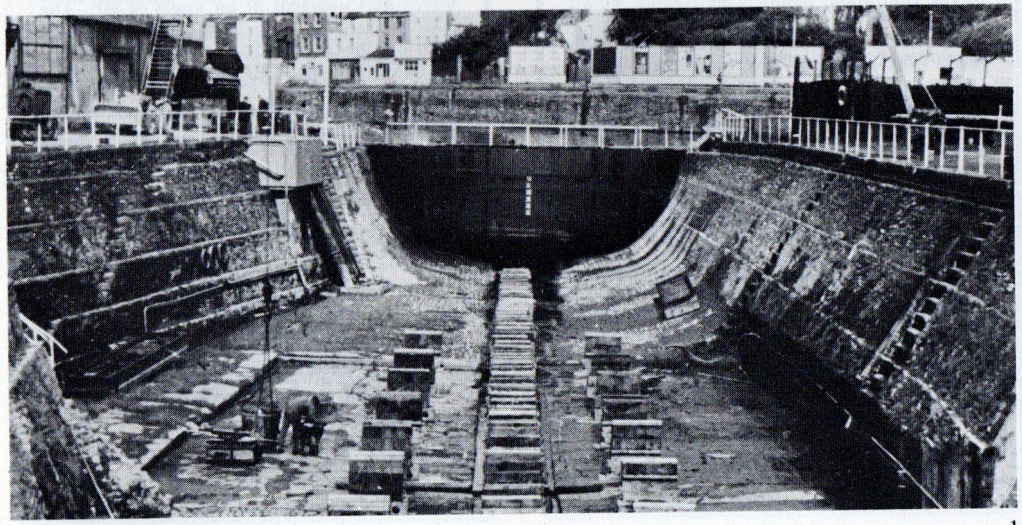
'The resistance of vessels on the water does not increase in direct proportion to the tonnage. The tonnage increases with the cubes of their dimensions while the resistance increases at about their squares, so that a vessel of double the tonnage of another capable of containing an engine of twice the power does not really meet with twice the resistance. Speed therefore would be greater with the larger vessel, or the proportion of power in the engine and the consumption of fuel may be reduced.'

It was not surprising, therefore, that the vessel grew so dramatically in size, that when eventually launched she had reached 2,936 gross tons, or more than twice the tonnage of the *Great Western*.

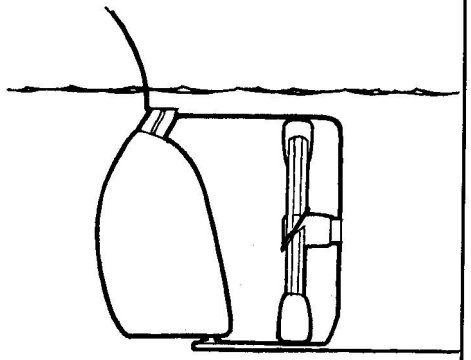
During this process, however, there had also been two fundamentally important new developments. The first was in 1838 when a little paddle-wheeler called the *Rainbow* visited Bristol. What intrigued Brunel about her was that she was built of iron. So he sent two of his colleagues, Captain Christopher Claxton and William Patterson, to join her for the rest of her voyage to Antwerp, and on their favourable report decided that his own great new ship must be of iron too. Then, since no firm was prepared to tender for such an unusual vessel, including, as it had to, larger paddle-wheel engines than had ever been built before, the Great Western Steamship Company itself took on the job. And, as the weight was thought to be too great for a traditional slipway, a fresh dry dock was constructed in Bristol, and special construction machinery installed on the quayside.

The second change of plan was even more radical than the first. In May 1840, ten months after the building of the big ship had actually started, another small experimental vessel, the *Archimedes*, arrived in the harbour and gave demonstrations of her novel screw-propeller, designed by Francis Pettitt Smith. Again Brunel was fascinated, and this time he chartered her for six months for experiments of his own. As a result he became convinced that he must alter the motive power of his own new vessel. Her engines would now be swung round by 90 degrees, and she would become the world's first ocean-going, propeller-driven ship. Her name was changed to *Great Britain*. A building committee was set up, consisting of Brunel, Claxton, and a Bristol engineer, Thomas Guppy. William Patterson, in whose yard the *Great Western* had been built and who with Brunel had drawn the lines of this new ship, was to supervise her construction in the dry dock—known as the Great Western Dock, which is where the *Great Britain* lies today.

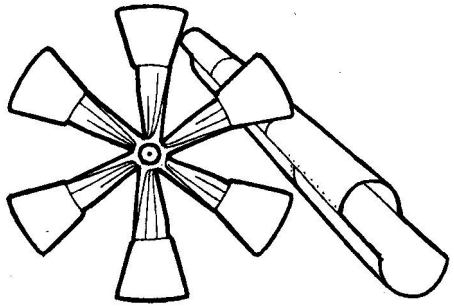
Great Western Drydock—Bristol



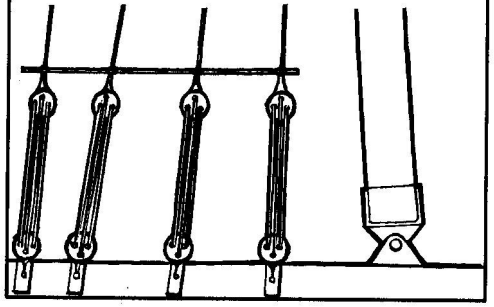
BALANCED RUDDER She was the first ship of any note to be fitted with a balanced rudder and a bolted rudder post. Its advantage was that it could be turned in the water far more easily than the conventional type of rudder, because its line of balance ran down through the centre.



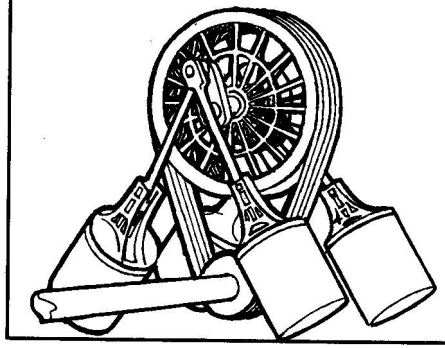
PROPELLER AND SHAFT The central section of the propeller shaft was a thin-walled tube 61 ft 7 in long and 30 in diameter, made from wrought iron plates 6 ft × 2 ft approx. At each end of this shaft were shorter, solid shafts revolving in bearings. The propeller, designed by Brunel, was the first large one ever built.



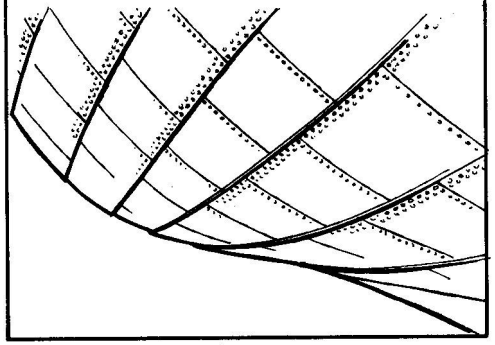
WIRE RIGGING AND HINGED MASTS The masts were rigged with wire rope instead of the traditional hemp. This rigging would then remain taut whatever the weather—unlike hemp—and hold the masts at whatever angle was required. The hinges allowed a certain amount of movement at the base of each mast in order to help the fitting of the wire rigging. Only one mast went through the ship to the keel, the hinged masts were stepped on the weather deck.



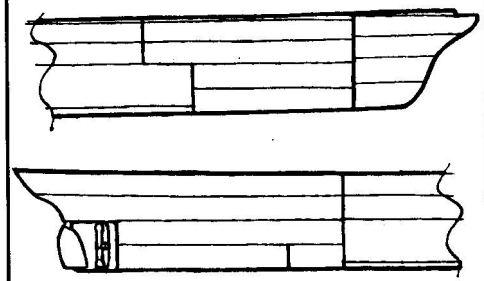
ENGINES AND DRIVE There were four cylinders working in pairs and inclined inwards and upwards at an angle of 60°. The pistons were 88 in in diameter and worked with a 72 in stroke to drive an overhead crankshaft. On this crankshaft was a wheel 18 ft in diameter and 38 in wide which, by a system of endless chains toothed on their inner side, turned a smaller 6 ft wheel on the propeller shaft below.



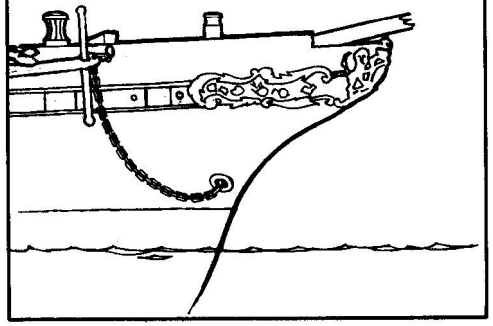
IRON PLATES The hull was constructed of wrought iron plates 6 ft × 2 ft 6 in approximately, riveted to metal frames. The plates overlapped each other, a method known as clinker-built, which gave fifteen per cent more strength than if the plates had been laid edge to edge. Since the plates were close-riveted the whole hull was virtually hand-built and has always been remarkably watertight.



BULKHEADS Five bulkheads ran across the inside of the *Great Britain's* hull, and there were two short longitudinal ones on either side of the engine-room. She was one of the first ships to be given such bulkheads which, besides giving great strength to the hull, also divided up the interior space into watertight compartments, which could be sealed by watertight doors.



CLIPPER BOW She was the first large ship to be designed with this type of bow; it was designed for speed and cut the water, in contrast to the traditional rounder, bluffer style of bow which punched its way through. The bow and underside of the ship have very fine lines, whereas above the waterline she bulges perceptibly in order to provide as much space as possible.



VITAL STATISTICS

Length (excluding bowsprit): 322 feet.
Breadth overall: 51 feet.
Tonnage: 3443 burthen, 1016 net registered (on which her dues would be paid).
Accommodation: After saloon 110 feet long; forward saloon 61 feet long; after dining saloon 98 feet 6 inches long, forward dining saloon 61 feet long.
Capacity 252 passengers with berths (360 could be carried if necessary but not all with berths); 26 single cabins, 113 two-berth cabins. Crew 130. Cargo 1200 tons. Coal bunkers fore and aft and alongside the engines—1000-1200 tons.
Cost: (1843) Construction £117,295 6s. 7d. Building facilities at her dock: £53,081 12s. 9d. Widening the Bristol locks: £1,330 4s. 9d.

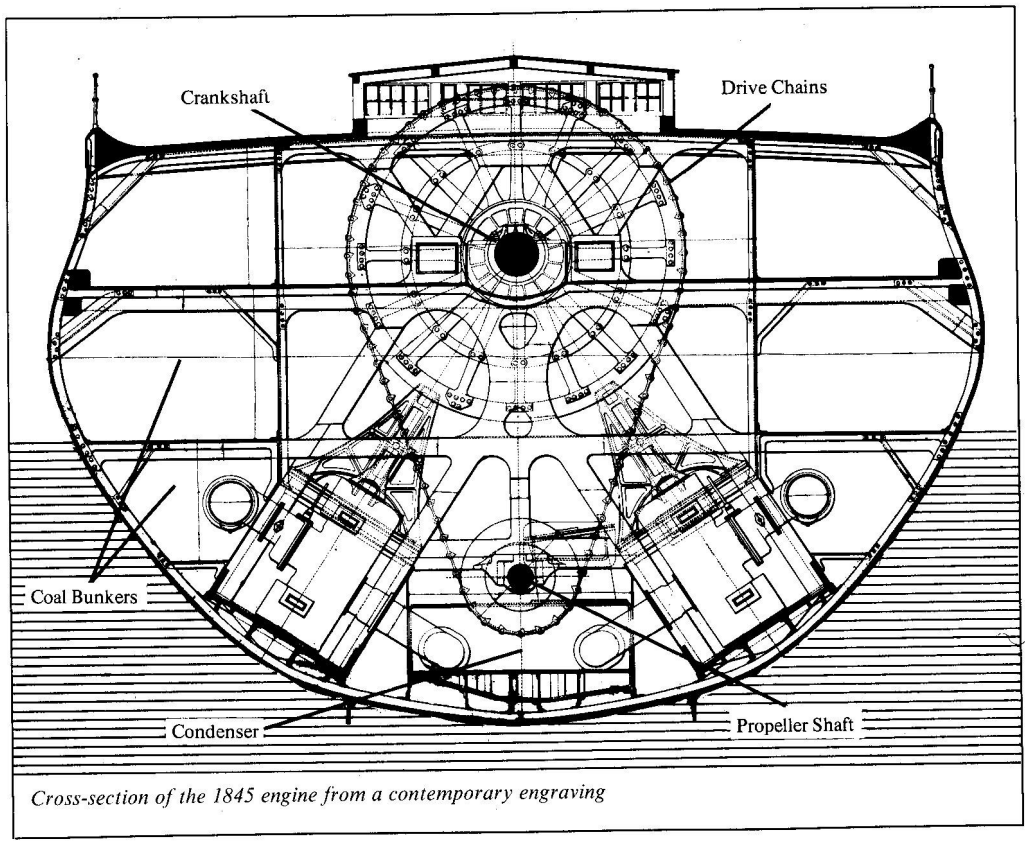
Construction

The first plates of the iron keel had been laid in this dock on July 19th, 1839. But at around 3,000 tons this was to be a vessel not only famous for her size and screw—a number of other features on the frontiers of contemporary knowledge also combined to make her one of the most historically interesting ships ever built. The bottom was given strength and longitudinal stiffness by a series of ten deep girders running fore and aft, on top of which was more plating, a form of construction later to be developed into the modern double-bottom. There were five transverse bulkheads, designed to be watertight in the event of collision or stranding. And aft of the epoch-making propeller, Brunel placed for the first time a balanced rudder, with the result that the steering of the ship was singularly light. She was said to handle like a yacht.

The *Great Britain* was a very strong ship, particularly compared with the wooden ones of her own times. Brunel had realised that with the *Great Western* the limits of what was possible with wood had been reached. In addition to the massive main iron members of his new ship, moreover, the structure of the sides with frames of angle iron 6 inches by 3½ inches, spaced on average some 20 inches apart, set a new standard of strength which affected all subsequent marine engineering.

The original six-bladed propeller was 15 feet 6 inches in diameter and weighed 4 tons, and modern tank tests with a scale model have revealed that its efficiency compares not unfavourably with propellers fitted to the supertankers of today. To drive it was an engine developing something over 1,600 horsepower, consisting of four large cylinders using steam at 5 pounds per square inch raised from salt water heated by coal-fired furnaces. Among the boiler's technical features was the use of waste heat to pre-heat the feed water, which was stored in a circular tank fitted like a jacket round the base of the funnel.

The original *Great Britain* was designed to be a steamer with auxiliary sail, which was only to be used to save coal when the wind was favourable. Her sailing arrangements were thus unique, with no less than six relatively short masts. These were said to have been nicknamed with the days of the week from Monday forward to Saturday aft, but were known officially as fore, main, one, two, three and four. The only one made of metal, the mainmast was also the only one stepped right down to the keel and square-rigged. The other masts were fitted with fore-and-aft sails and were hinged at their bases on the deck. All the original rigging was of iron wire—another innovation; it was needed to hold the hinged masts sufficiently rigid. Although in a ribald comment *The Times* compared these arrangements with 'a laundress's yard prepared with the props and wires for hanging out the clothes', Brunel's idea was to save labour. Almost all sails could be worked from the deck and needed only some thirty men to handle them. The bulk of the crew were required below decks, many of them working in the boiler room.

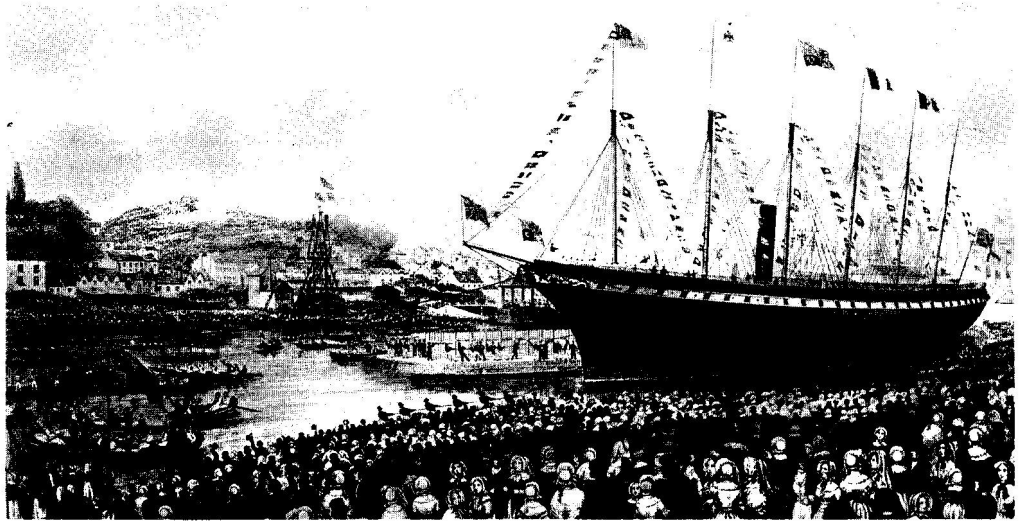


Cross-section of the 1845 engine from a contemporary engraving

The top, or weatherdeck, was of pine planks and, following sailing ship practice, was left as uncluttered as possible to make the working of the sails easier. Apart from the masts themselves, however, in this great new ship there had to be some very special features coming up through the deck. There were eighteen skylights to give light to the promenade deck below, several companionways for access by crew and passengers, and a huge engine-room skylight which also covered the top of the massive driving wheel. Since the four cylinders of the engine were so mounted in the bottom of the ship that their pistons drove upwards to turn a crankshaft above them, this main driving wheel protruded some four feet above deck level, and by means of a multiple chain drive, conveyed the power down again to the propeller shaft. It was a singular piece of engineering and the passengers could watch it through the skylight with fascination. Contrary to modern practice, the engine turned more slowly than the propeller, so that there was a gearing of three turns of the chain-driven propeller shaft to every turn of the main driving wheel at deck level above. And over everything else on deck there towered the black 38 feet high funnel.

This, then, was the unique new ship which must have looked a splendid sight as she lay in her drydock awaiting her launch on July 19th, 1843. Her gleaming black hull had a broad white band painted round it, with black squares like gun ports. The decorations at her stern were picked out in gold, and on her masts flew the flags of the United States, Russia, France and Belgium. At her bow were the finest decorations of all, consisting of a figure-head with the royal arms, and white and gilded trailboards on either side, on which emblems of Victorian art and industry were carved—a coil of rope, two cogwheels, a dove, a set square, an artist's palette, a wheatsheaf, and the caduceus or winged staff of Mercury, symbolizing speed.

The Great Britain *leaving Great Western Dock 19th July, 1843*



Working Life

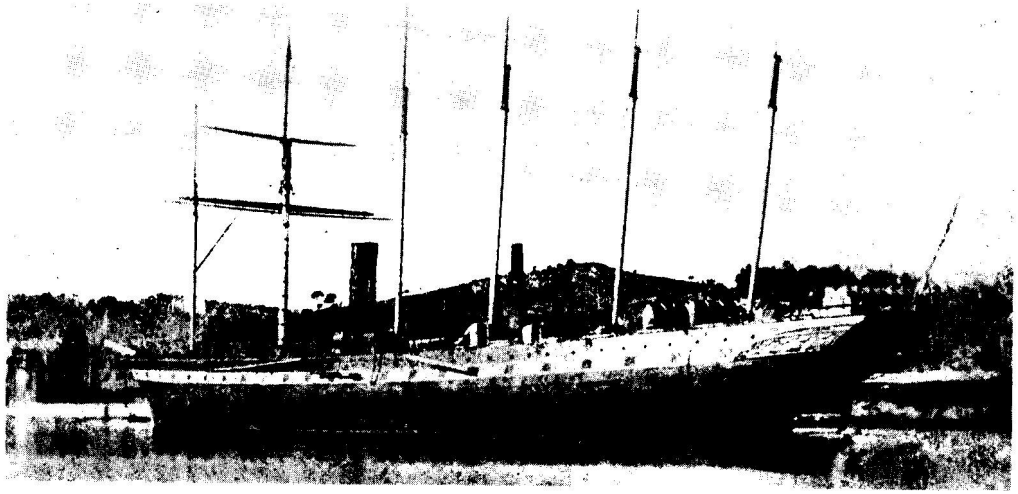
The launch—or first flooding of the dry-dock—took place in the presence of the Prince Consort, Prince Albert. He travelled down from London on Brunel's Great Western Railway. And the ageing Sir Marc Brunel emerged from retirement to attend the celebrations. The Prince had breakfast at Temple Meads Station, rode in procession through the city of Bristol, and reached the Great Western Dock at noon.

Bristol itself was in holiday mood as thousands watched from the surrounding hills. The *Bristol Mirror* reported: 'The day has been observed as a complete holiday. All the shops are shut, and business entirely suspended. Every church has displayed its flags, the ships have been dressed out in a variety of colours; peals have rung, and cannon fired; indeed every demonstration has been made that loyalty and rejoicing could inspire.'

Prince Albert then looked over the ship: 'A splendid regimental band was stationed on board the *Great Britain* and added much to the enlivening of the scene. As His Royal Highness walked from stem to stern of the noble ship, the numerous visitors who were on board had an ample opportunity of looking upon the consort of our beloved sovereign, and His Royal Highness returned with much courtesy and condescension the marks of respect with which he was everywhere greeted.' Afterwards the Prince had lunch in one of the workshops alongside.

While he did so, water was being admitted to the dock so that the *Great Britain* floated off her building blocks. The wife of one of the company's directors, Mrs John Miles, who had also launched the *Great Western*, was then to perform the naming ceremony as the ship began to be eased out of the dock. A line was fastened to the small screw steamer *Avon* out in the harbour, and other ropes were manhandled by shipyard workers. Unfortunately as the *Great Britain* was pulled slowly forward, Mrs Miles missed the bow with the bottle of champagne. At this, Prince Albert himself seized a second bottle and hurled it at the bows, where it was well and truly smashed on the great iron stem. The *Great Britain* was drawn across the harbour to what is now the Gas Works Wharf, where she was temporarily secured. Later she was hauled back to float in her building dock for fitting out, including the installation of her engines.

It was not till late in the following year, 1844, that she was ready to be moved out of the Floating Harbour, through the locks into the River Avon, and down the six miles of the river to the open sea of the Bristol Channel. But now a further problem had to be faced. Because the promised action had not yet been taken to widen the two locks into and out of the Cumberland Basin, there would be the very greatest difficulty in getting her through. It was only after she had indeed stuck fast at one moment, and in some danger, had been hauled back again, that the top coping stones were removed as a matter of emer-



Taken by Fox-Talbot, the first photograph of the Great Britain *shows her lying alongside Gas Works Wharf*

gency and the following day she finally passed through. She was towed down the Avon at last on December 12th, 1844, by the tug *Samson*.

During the passage, however, steam was raised and preliminary trials in the Bristol Channel were started at once. With the new engines being turned at first at only 6 revolutions per minute she made a speed of 4 knots. Speed was slowly increased after reaching Portishead and at 16 revolutions, with only 18 of the 24 furnaces lit, the *Great Britain* was cutting through the water at 11 knots. When steering experiments were tried with the balanced rudder, it was found that she answered the helm to perfection. Everyone remarked upon the extraordinary lack of vibration and noise, and it rapidly became clear that the behaviour of the whole ship came up to the very highest expectations.

Official trials began on January 8th, 1845, and she was formally registered on January 14th, and given the official number 25967, which could still be seen carved on one of her hatch coamings when she was salvaged from the Falkland Islands 125 years later.

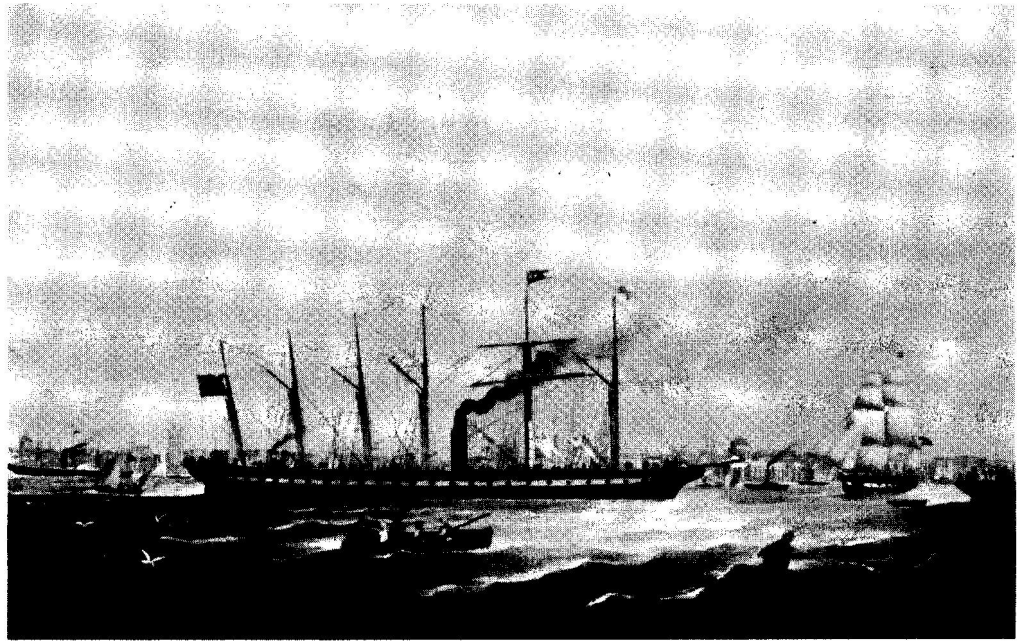
Thus the *Great Britain* started her incredibly long service life. The first 31 years were to be as a passenger ship, the next 10 spent carrying cargo only, and the last 51 years she spent afloat in Stanley Harbour as a storage vessel. Wherever she went she received a highly enthusiastic welcome, and despite various setbacks in her career she always remained an extremely popular ship, remembered with pride and affection by her crew, by her passengers, and by the general public alike. And although by the end of her passenger service she inevitably became obsolescent, in her early years she was far ahead of her time and stood out as a symbol of power and luxury, the very essence of Victorian supremacy.

Her first captain was James Hosken, who had earlier served in the Royal Navy as a Lieutenant, and it was under his command that on January 23rd, 1845, she set off on her trial voyage round Land's End and up the Channel to the Thames, where the final touches were to be made to her fitting out, and where she would be visited by Queen Victoria. It was during this passage on the very first day out at 3 pm on January 24th, 1845, that she ran into an exceptionally heavy sea off Lundy Island and suffered minor damage on the starboard bow; the scene is depicted in the famous painting by J. Walter, who had in fact been on board at the time. But she stood up to it so well that Brunel's basic design was immediately vindicated.

The *Great Britain* remained in the Thames for five months, visited by many thousands of people as well as by the royal family. Queen Victoria, it was recalled by the *Illustrated London News*, 'While in the (first class) dining room sat down on one of the chairs, which was placed in such a position that enabled her to see the effect of the mirrors, which made this extensive apartment appear almost boundless.'

As described in Captain Claxton's book about the ship, the dining room—like the promenade saloon above it—was 'a really beautiful room. Down the centre are twelve principal columns of white and gold, with ornamental capitals. . . . Twelve similar columns also range down the walls on either side. . . . (Between them) are seven doors which open into as many passages, each of which communicates with four bedrooms. The archways of the several doors are tastefully covered and gilded and are surmounted with neat medallion heads. The walls . . . are of a delicate

Great Britain *on her return from the first screw-propelled crossing of the Atlantic*

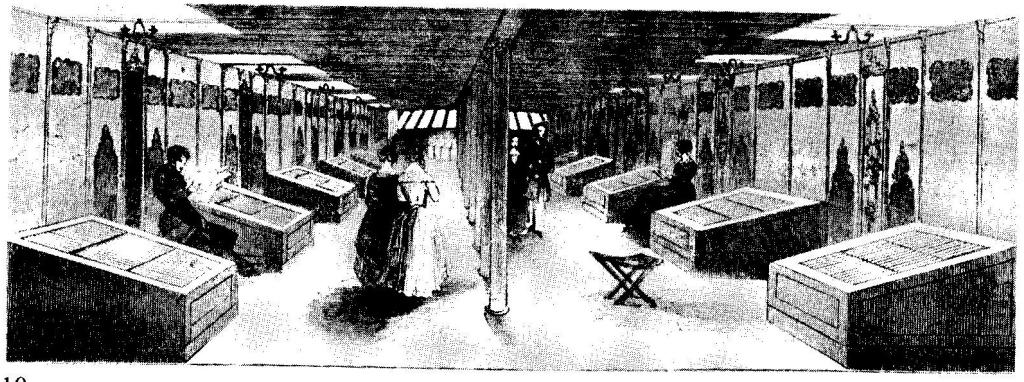


lemon-tinted drab hue, relieved with blue, white and gold.' This main dining room and the equally decorated promenade saloon above it are the two basic parts of the ship's accommodation which it is intended to restore in full, together with a number of specimen cabins—whose arrangement was the same on the promenade deck as those which surrounded the dining room. Although the lay-out of the cabins and their passageways is familiar enough to-day, in the Brunel ship it helped to establish new standards of comfort and amenity.

In addition, as Claxton put it: 'From the ship's bottom to the upper deck runs on either side for the whole length of the engines and boiler space a strong iron partition forming: below—the coal bunkers; and above—the servants' accommodation on one side, engineers cabin and stokers' accommodation on the other, besides twenty six water closets.' Space for the crew was provided in the forecastle right up in the bows, the officers being directly under the weatherdeck and the other members of the crew below them. The glass for the portholes throughout the ship was one inch thick. But it was the engines which impressed visitors the most, partly for their size and partly—particularly for those who made their way along the 'long, narrow and extended chamber of the huge . . . (propeller) shaft'—for the almost eerie quality of this unfamiliar mass of machinery at rest.

On June 12th, 1845, the *Great Britain* sailed for Liverpool, where she again averaged 2,500 visitors a day, pending the start of her maiden voyage across the Atlantic on July 26th. For that she carried some 50 passengers—she had accommodation for 360, but people were still a little afraid of her—and 600 tons of cargo. She covered the 3,300 miles to New York in 14 days, 21 hours at an average speed of 9.4 knots. In spite of a certain amount of rolling, the fresh westerly gales, and some vibration—though less than paddle-wheels would have produced—this was a splendid performance by any standard. And the welcome as she steamed up the Hudson was tremendous. Once again, on arrival she was thrown open to the public, who

Looking aft through the original Promenade Saloon of the Great Britain *with staterooms or cabins ranged along each side. The box-shaped fittings gave light to the dining room below*



poured on board.

Nineteen days later, on August 30th, she set out from New York for the return voyage to Liverpool with 55 passengers and a cargo consisting largely of cotton. Her best day's run was at 12 knots and, in spite of the main topmast being carried away in a storm as well as some trouble keeping steam up in the boilers, she made the passage in 13½ days at an overall average of 9 knots, taking a slightly shorter route. The double crossing had been an immensely encouraging success.

The *Great Britain* made a second voyage to New York that year, leaving Liverpool with 102 passengers on September 27th and arriving in America on October 15th, a less successful passage of 18 days. However, she ran into very bad weather from the start and averaged less than 7 knots for the first 2,700 miles. Then as a result of strong winds and the current off the American coast, Captain Hosken failed to keep her sufficiently clear of the Nantucket shoals. On the thick and dirty night of October 12th she almost certainly at one moment touched ground. As a result she sustained severe damage to the propeller. On arrival in New York she was drydocked.

Emergency repairs were made to the propeller, a blade was re-positioned to offset one that had been lost and all the loosened rivets tightened. She sailed again for Liverpool on October 28th under reduced power. An uneven balance in the propeller, however, and the fact that the emergency repairs had been insufficient to prevent further blades breaking off finally compelled Captain Hosken to discontinue the use of the engines altogether on November 8th. She carried on under sail alone, arriving in Liverpool on November 17th, a voyage of 20 days. At the end of it everyone was delighted with the *Great Britain's* purely sailing qualities and the passengers presented an address of congratulation to the captain.

The remains of the original six-bladed propeller were now removed and a new design with four blades was substituted. Thus ended this first historic experiment. The *Great Britain* was laid up for the winter and besides changing her propeller as well as the air intake to the boilers, she was re-rigged. The number of her masts was reduced from six to five, in order to improve her sailing qualities; and the hinges at deck level were done away with. If the original propeller had not been damaged at Nantucket, it might have been retained for longer. Although structurally weak because of the limited technical knowledge of the time, its design as such had proved a considerable success, and inevitably these were years of rapid change both in design and in technique. Later on in her career the *Great Britain* was to settle down to a two-bladed propeller. But as the true pioneer she had already achieved a unique place in history.

After the winter refit, the ship made her third and fourth voyages to New York in May and July, 1846. While a better power output was obtained from the altered boilers and the new propeller, the third outward voyage was again slowed down by mechanical trouble, with a fracture in the after air pump that again led to a temporary shutdown of the engines. Following the previous season's setbacks there were still no more than 28 passengers on board, and the voyage again took as much as 20 days. It was on the return run that the *Great Britain* at last seemed to get over her teething troubles. With 42

passengers she sailed from New York on June 8th and made the crossing in 13½ days, in one 24-hour period maintaining a constant speed of 13 knots—which, if kept up would have meant an 8½ day passage. When fully worked up, indeed, it began to look as if the target of a basic 10 knots westbound and 12 knots eastbound, might be attained, giving an average passage of 13 days out and 11 home.

Success breeds success and for her fourth outward voyage, leaving Liverpool on July 7th, 1846, as many as 110 passengers had at last embarked on the *Great Britain*. But complete success still eluded her, as a result, it would seem once more, of faulty navigation. In thick fog on the Newfoundland Banks she again touched bottom, though this time only scraping a bilge instead of damaging the propeller. Even so the voyage took little over 13 days at an average speed of nearly 10 knots. The return trip was accomplished in a few hours less, in spite of a break at one point in one of the driving chains.

It was some measure of the growing confidence in the ship that for her fifth voyage, leaving Liverpool at 11 am on September 22nd, 1846, she embarked a record 180 passengers and a substantial cargo. It was on this voyage, however, that disaster finally struck.

In the light of subsequent events doubt at least must be cast on Captain Hosken as a navigator, by virtue of his having twice before grounded the *Great Britain*. This time, in what was described in the contemporary *Mechanics Magazine* as 'the most egregious blundering', he finally put an end to the original ship as Brunel had designed her, and broke the Great Western Steamship Company which had so bravely built and developed her.

At about 10 o'clock that same night of September 22nd the *Great Britain* ran at some speed hard ashore on the beach of Dundrum Bay in County Down on the East coast of Ireland. To this day it still seems extraordinary that this should have happened. It was a dark wet night but not unduly stormy, and the actual cause of the stranding was that the crew had failed to see the Chicken Rock Light on the Isle of Man, which should have given them their position for making the turn northward on a course that would have taken the ship between the Isle of Man and the Irish coast. Then, when they did see what was in fact St John's Light on the Irish coast, they assumed it was the Calf of Man, and, thinking to carry on for a while before making the northward turn, ran straight into Dundrum Bay, which was ahead of them just south of the lighthouse.

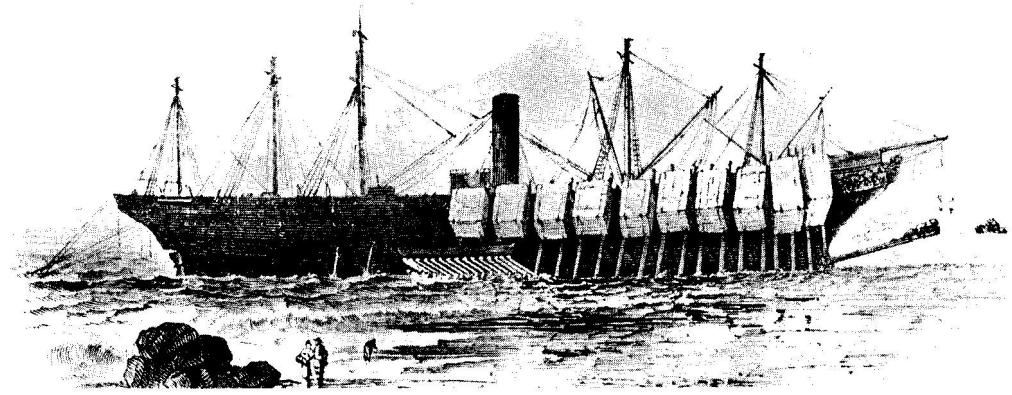
Captain Hosken had in fact gravely underestimated the speed at which he had been running for the past several hours. He then failed to exercise due caution by slowing down and feeling his way when a strange light was seen, which by its nature and precise position did in any case puzzle those on watch. At one moment the compass was blamed and later so were the charts. But the case was quite unproven. The simple fact remained that, however it had happened, that night the *Great Britain* was a very long way from the position in which she was thought to be.

No one was seriously injured in the stranding and all spent the rest of an agonizing night on board, with the waves breaking against the ship. At daybreak, when the passengers were safely disembarked it was clear that, although leaking slightly, the vessel was so strongly built that she was not badly damaged. But she was very firmly ashore indeed, lying between two lines of rocks, and there was no question whatever of getting her off straightaway.

As soon as news of the disaster reached the company in Bristol, Captain Claxton left immediately for Dundrum Bay, and on October 1st, as a gale began to blow up from the south, he ordered sail to be raised and drove the ship further up the beach in order to protect her from the waves, which were by now breaking over her, and had already carried away the rudder post, as a result of attaching two anchors to it. Attempts were made to erect a breakwater of heavy timber, while plans for her salvage could be made. But it was not until Brunel himself arrived in December, dismayed and furious at all that had happened, that adequate measures were taken.

The *Great Britain* was protected throughout the winter by a combination of faggots, rocks and timber. Alexander Bremner, the leading salvage expert of the time, was called in. And the following spring the ship was ingeniously lifted just clear enough of the sand for boilermakers to repair her damaged plates. This was done by driving huge logs into the beach on either side. Ropes were run over the tops of them, and underneath the hull. At the ends of the ropes were attached twenty boxes of sand, each weighing fifty tons when filled. As the boxes descended, so the ship would come up. Then stones and timber were pushed into the cavity, so that at each operation she rested a little higher. Finally, by August of this following year, 1847, at each high tide it was possible to winch her towards the sea with a combination of ground tackle and tow ropes from two naval vessels, HMS *Birkenhead* (famous later for a tragic troopship disaster off South Africa) and HMS *Scourge*. At last on August 27th she was afloat and free. She was towed back to Liverpool for repair in the shipyard of Fawcett, Preston and Company.

The ingenious arrangements of weights and levers devised by James Bremner to refloat the ship in 1847



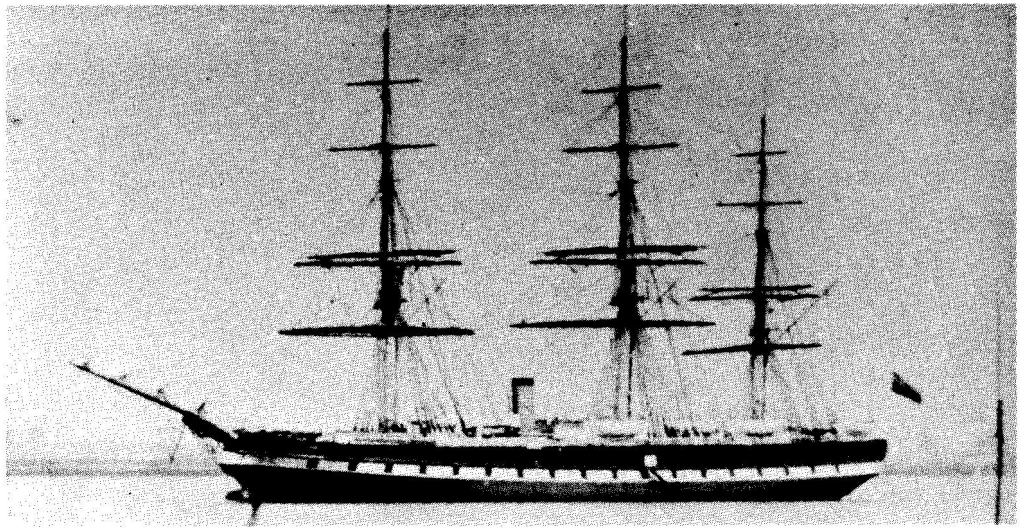
Her new owners, however, were not satisfied with her performance and carried out further modifications. The two funnels were replaced with a single small one, and the *Great Britain* was now fitted with three square-rigged masts, all heavily sparred, and a large bowsprit. In 1857 she had a further extensive refit when each of the masts was replaced. Finally, a new stern frame was installed, designed to take a two-bladed propeller which could be lifted clear of the water when the ship was under sail. But this was at last the end of the long saga of changes, and in this form the *Great Britain* settled down to nearly twenty years of steady passages between Liverpool and Melbourne, carrying the forebears of probably a quarter of a million present-day Australians.

After the first exceptional voyage, she always continued eastwards for the return passage, travelling the route of the sailing ships, and circumnavigating the globe on each completed trip. Averaging 60 days out, and about the same back she made 32 such round voyages before becoming obsolescent in 1876 after 30 years at sea. It was a splendid record.

On board there was a high standard of comfort for the first-class passengers. At the start of a voyage the ship carried live sheep, pigs, fowls, ducks, geese and turkeys, as well as a quantity of dead meat, eggs, potatoes and vegetables. Her fresh water tanks held 35,338 gallons and she was fitted with two condensers capable of producing 1,500 gallons of fresh water a day from sea water. The passengers in general were expected to help the crew at times in working the heavy capstans to lift the anchor or the propeller, and they seemed to appreciate the informality and change of routine. Anyway, it was good exercise!

The climate through which the ship passed on her trips to Australia varied a great deal. Sometimes there was snow on the decks and snowballs flew in all

As re-rigged in 1857 prior to 20 years' service between England and Australia



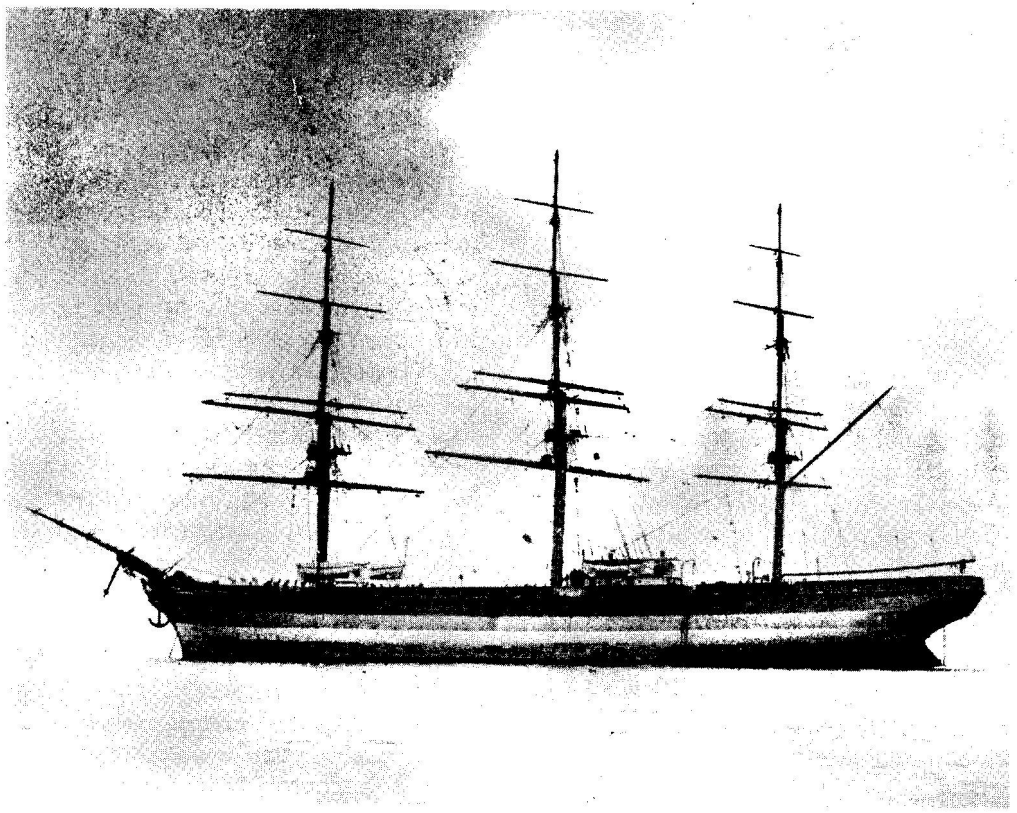
The first all-England cricket eleven to visit Australia was carried by the Great Britain *in 1861*

directions; sometimes it was so hot that awnings had to be rigged to provide shade, whilst below decks it became difficult to breathe. In the hot weather many people preferred to sleep on deck. The passengers amused themselves by reading, playing cards and chess, organising debates and dances, and running muscial recitals, singsongs and concerts. For the steerage passengers life was not so pleasant. The emigrants were a motley group of English, Irish, Scots, French, Swiss, Germans, Hungarians, and Americans. Many of them spent their time drinking, quarrelling, swearing and gambling.

Before her third Australian voyage in 1854 Captain John Gray had succeeded to the command. He had started as Second Mate and rose to become the *Great Britain*'s best-known, most successful, and longest lasting captain. He was eventually lost overboard at sea in 1868 in circumstances that were never fully explained. While under his command the ship was twice requisitioned for trooping, first in 1855–6 for the Crimean War, and then again in 1857 to go to Bombay during the 'Indian Mutiny'. After this national service the *Great Britain* twice again made voyages to New York before resuming her Australian service. In 1861 she took out the first ever English cricket team to visit Melbourne.

In 1876, her passenger usefulness over, the ship was laid up at Birkenhead and offered for sale. In 1882 she was bought by a related company, Antony Gibbs, Sons and Co., for use as a cargo sailing ship. All the passenger accommodation was removed and so were her engines. The company put in three large hatches for loading cargo and bolted a thick, caulked, pitch pine cladding right round the iron hull between low and high loading marks, as an additional strengthening factor. In this form she was used for carrying South Wales coal to Panama and San Francisco, and returning with wheat. Under the command of Captain Henry Stap she travelled both outwards and homewards round Cape Horn. These were long slow voyages, each round trip lasting over a year, the first from November 1882, to January 1884, and the second from May 1884, to July 1885.

It was on her third such voyage that she finally came to grief. She sailed for San Francisco from Penarth in South Wales on February 6th, 1886, on what was logged as Voyage No. 47. For a sailing ship, rounding Cape Horn from east to west is always far more of a problem than in the opposite direction owing to the strength of the prevailing westerly winds. And by April 18th when the *Great Britain* had reached a point nearly off Cape Horn itself, the winds were such that she began to get into serious difficulties. Waves were breaking right over her, her decks were leaking, and the old hull deep laden with coal was felt to be straining in the mountainous seas. The crew asked Captain Stap to put back to the Falklands, but he resolutely refused. They struggled on for no less than another three weeks without making significant progress. On April 21st the cargo had shifted, producing a list to port—which Captain Stap corrected by shovelling the coal back—and on May 10th the fore and main topgallant masts were both lost overboard. On May 13th the crew once again came aft in a body and approached the Master. This time Captain Stap accepted. They turned and ran before the gale, reaching shelter in Port Stanley in the Falkland Islands on May 26th,



The Great Britain *converted into a sailing cargo ship in 1882*

1886. The *Great Britain*, worn and damaged, never sailed again.

Offered for sale owing to the cost of repairs, the *Great Britain* was bought by the Falkland Islands Company as a store ship. Dealing in trade and sheep farming, the company used her for coal and wool. It was almost exactly forty years since, in all her various forms, she had been at sea. Now she was destined to spend another fifty years afloat in Stanley harbour.

At last, in 1937, very nearly a century since Brunel had first sat down to design her, the *Great Britain* became uneconomic to operate even as a store ship, and the company replaced her with the *Fennia*. On April 12th of that year she was accordingly disposed of—it was thought for ever—by being towed 3½ miles out of the harbour and beached on the other side of the waterway in lonely Sparrow Cove. On April 13th, 1937, holes were knocked in her stern and one amidships to ensure that she would never float off again. She became the haunt of sea-birds and was left to rot, but nevertheless became a famous landmark and a centre of affection and pride among the people of the Falkland Islands.

Recovery

As the years went by, however, she had not been forgotten elsewhere. During the 1950's, on the other side of the world, Karl Kortum, the Director of the San Francisco Maritime Museum, began trying to arouse interest in the salvage and restoration of the *Great Britain* as one of the most historic ships ever built. In 1952 in England, Ewan Corlett, a naval architect, was given a lithograph showing the *Great Britain* off Lundy Island in 1845. And he felt inspired enough to begin a detailed research into her long and fascinating history.

Coincidentally in the year 1967, each of them quite independently took further action. Kortum visited the Falklands and examined the ship, having secured the interest of one of his museum's trustees, millionaire William Swigert. And Corlett did what the British do when they feel strongly about something. On November 8th, 1967, he wrote a letter to *The Times*, urging that 'the first iron-built ocean-going steamship and the first to be driven entirely by a propeller' should at least be fully documented by the authorities, and that at best they should, 'do something to recover the ship and place her on display'.

Financed by Bill Swigert, the Americans spent many thousands of dollars in their effort to determine whether and how the *Great Britain* could be salvaged and brought to San Francisco. But when in 1968 two meetings were held in England, the first in London and the second in Bristol, to decide whether a British attempt at salvage was practicable, the American group gallantly stood back. Swigert, who had accepted an invitation to come to the Bristol meeting in May 1968, declared that, if indeed the British could do it, they had a prior claim to bring the *Great Britain* back to her birthplace—Great Britain.

That summer (1968) an effective British group was in fact formed with Richard Goold-Adams as chairman and it adopted the title of 'ss Great Britain Project'. In the autumn Ewan Corlett went out to the Falklands. With valuable help from the ship's company of HMS *Endurance*, on board which he had travelled from the mainland with the Admiralty's blessing, he conducted the first thorough-going professional naval architect's survey of the *Great Britain* ever made since her beaching in Sparrow Cove 31 years earlier. And his conclusion was that she could be refloated.

Still derided by the sceptics, of whom there were many, the ss Great Britain Project decided that, come what may, the salvage should and would be achieved. In April of the following year, 1969, Prince Philip sent a very welcome message of encouragement, and funds had started to trickle in. It was in July that the main financial problem was solved. In a conversation with Richard Goold-Adams, Jack Hayward, the Bahamas-based British philanthropist, promised up to £150,000 towards the cost of bringing her home.

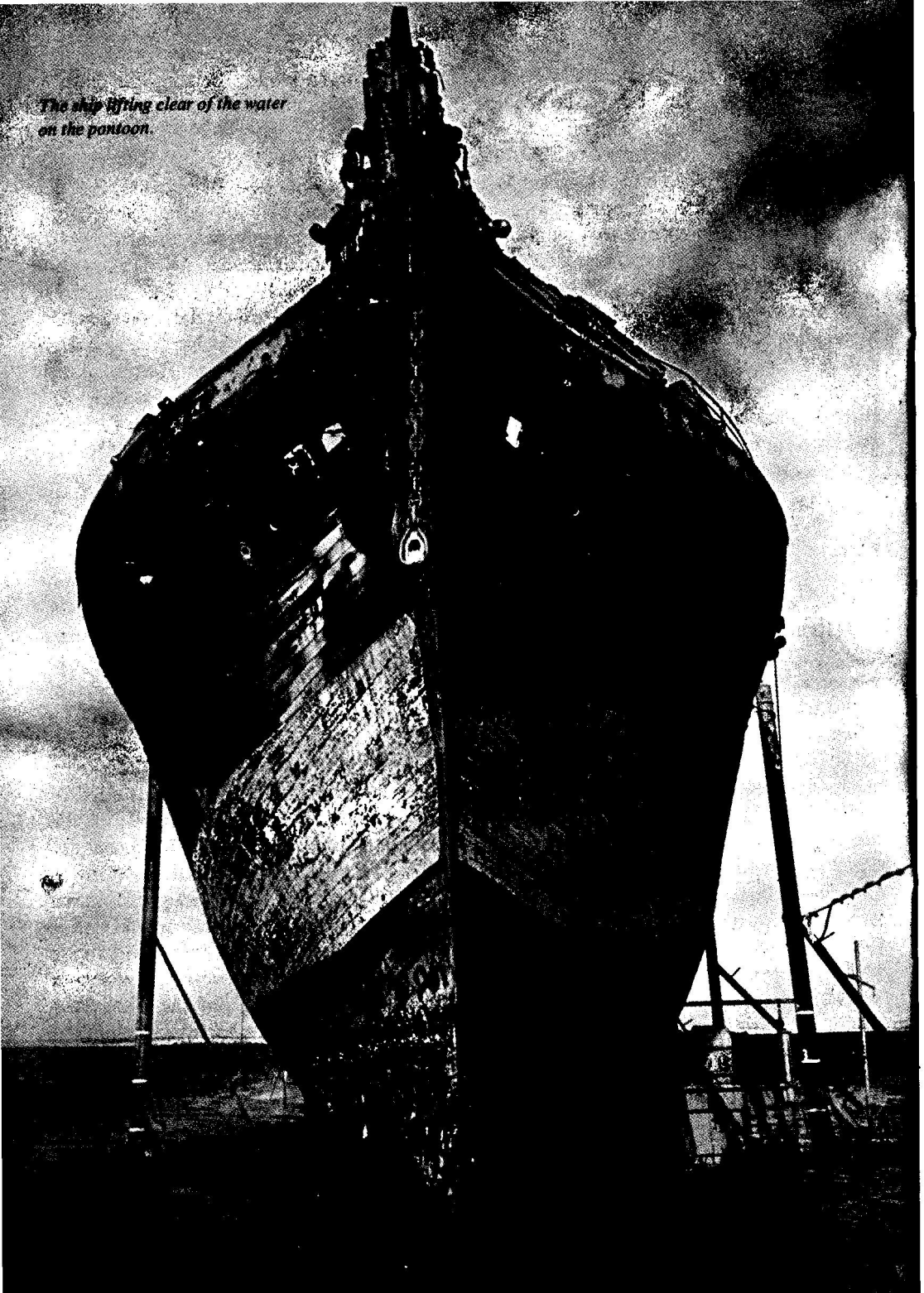
The questions now were how, and by whom would the salvage be achieved. Detailed technical assessments had been made by Burness, Corlett and Partners, naval architects, and eventually in February of 1970 the Project chartered, through Risdon Beazley Ulrich Harms Ltd of Southampton, a large submersible pontoon, *Mulus III*, of 2,667 tons gross. The charter was subject to a reconnaissance on the spot by the company's salvage officer in charge of the operation, Leslie O'Neil. He visited the *Great Britain* in January—helped once again by passage back to Montevideo in HMS *Endurance*. His report assessed the chances of success in getting the *Great Britain* on to the pontoon and being towed to Bristol at 80 per cent—exactly as Ewan Corlett had done. So on February 4th, 1970, the tug and pontoon left West Africa, where their previous charter had been, and headed for the Falklands with a stop at Montevideo on the way to buy stores. They cost the Project £820 a day.

The drama of these developments was heightened at the time by the fact that the Project felt it could say nothing publicly, until Falkland Island opinion had become reconciled to the salvage attempt. Local opinion at first was opposed to the whole idea, since almost no one in the Falklands believed that the *Great Britain* could be refloated and got away safely. This opposition made it virtually impossible for the Governor, Sir Cosmo Haskard, to recommend to the authorities in London that the Crown should release the ship, which had officially become a Crown wreck when beached in 1937. Naturally, discussions had been initiated some time before, when the Project formally applied for the release. But before a satisfactory decision could be reached in Stanley, the Project was suddenly presented with the chance of saving a great deal of both money and time by taking the tug and pontoon on from West Africa, already one third of the way to the Falklands. Seizing this chance was a considerable risk—though only one of the many that the whole salvage presented. Fortunately, just before the expedition reached Montevideo, the Governor was able to cable his recommendation of release. And then the news was broken to the world.

What was totally new, of course, was the concept of using the submersible pontoon. This was a technique which had only been developed in Hamburg by Ulrich Harms during the previous two years. And it was for this reason that the team which actually carried out the salvage was Anglo-German. The 15 German crew of the tug, *Varius II*, were joined in Montevideo by a British party of six which flew out from London, including Leslie O'Neil himself. Lord Strathcona, who was a member of the Project, went out with them and represented the Project both during the salvage and for the official handing over ceremony afterwards in Stanley by the Governor. Also present were a group of three from the BBC, who made a film record of the whole epic adventure. Invaluable help in terms of manpower and transport was given by the local detachment of Royal Marines under Captain Malcolm McLeod.

Among the vital stores bought in Montevideo were rough timber planking for making safe walkways to work from on the rotten deck, and steel tubing for use as a sheerlegs for hoisting out the *Great Britain*'s three massive masts, which risked damaging the hull if they broke and crashed down during the tow home. Another 15 tons of stores, ordered by O'Neil, had been shipped direct to Stanley from England, including welding and pumping equipment.

Varius II and her pontoon reached



The ship lifting clear of the water on the pontoon.

Stanley from Montevideo on March 25th after a very rough passage which lasted ten days. The day after arrival the whole party moved across to Sparrow Cove, and dropped anchor near the *Great Britain* on March 26th, 1970—daunted at first by what they saw. Not least forbidding was the cold and the wind. Although the season was still only the end of summer, the temperature averaged about 4°C and there were frequent gales.

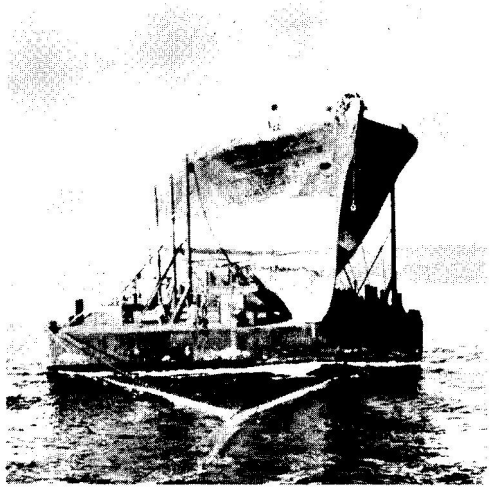
The pontoon itself was lashed end-on to the port side of the ship, and the sheerlegs was erected on the pontoon deck. From this stable platform work began at once on removing the masts. Meanwhile, three divers started patching the holes below the waterline. This was done by fitting plywood patches on the outside, hooking them tightly on to pieces of angle iron across the inside, and then sealing the whole area from the inside with hydraulic cement.

The thirteen-inch crack which had opened below the forward entry port on the starboard side as a result of the scouring of the tide, and which had always presented one of the vital problems in refloating the ship, was dealt with by a carefully pre-planned procedure. Although modified in the light of circumstance, the essence of the plan was to bolt three steel strip plates across it at each of the upper three deck levels, each piece of steel measuring 30 feet long, 1 foot wide and ½ inch thick. Into the crack itself were tightly stuffed a dozen old mattresses. As soon as the ship began to be water-borne the pressure would close the crack, squeezing the mattresses and bending the steel strips. And this was what duly happened. The straps were then cut, straightened, and lap-welded back into place, and concrete poured in behind as a seal.

Although the *Great Britain* was refloated satisfactorily, bad weather and an initial miscalculation about the draught she would draw in her damaged condition delayed her getting on to the submerged pontoon for several days. But by April 12th, 33 years to the very day since she had been beached in Sparrow Cove 'for ever', the pontoon was being pumped out and the ship was being lifted clear of the water. As the full weight had been taken by the pontoon, the crack had closed fully and the slight twist to port in the stern had straightened itself—as Corlett had calculated would happen. By April 13th triumph was complete.

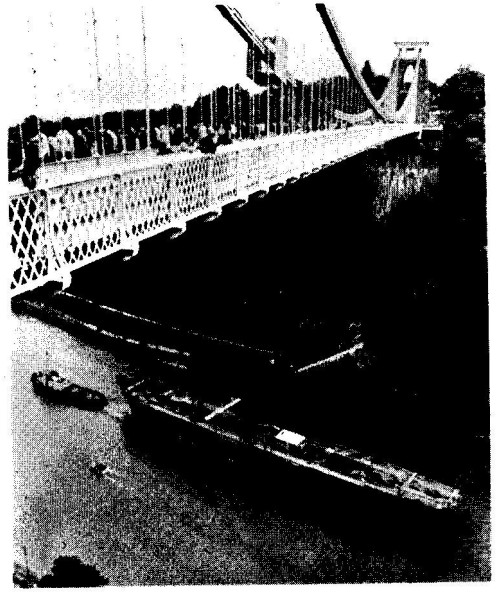
On April 14th the little flotilla entered Stanley Harbour. Ten days were spent wedging and fixing the ship more firmly on the pontoon for the 7,000 mile ocean tow. They left on April 24th, reached Montevideo safely on May 2nd, sailed again on May 6th after a rest for the crew and

Secure in her pontoon, the Great Britain *under tow and homeward bound. May 1970*



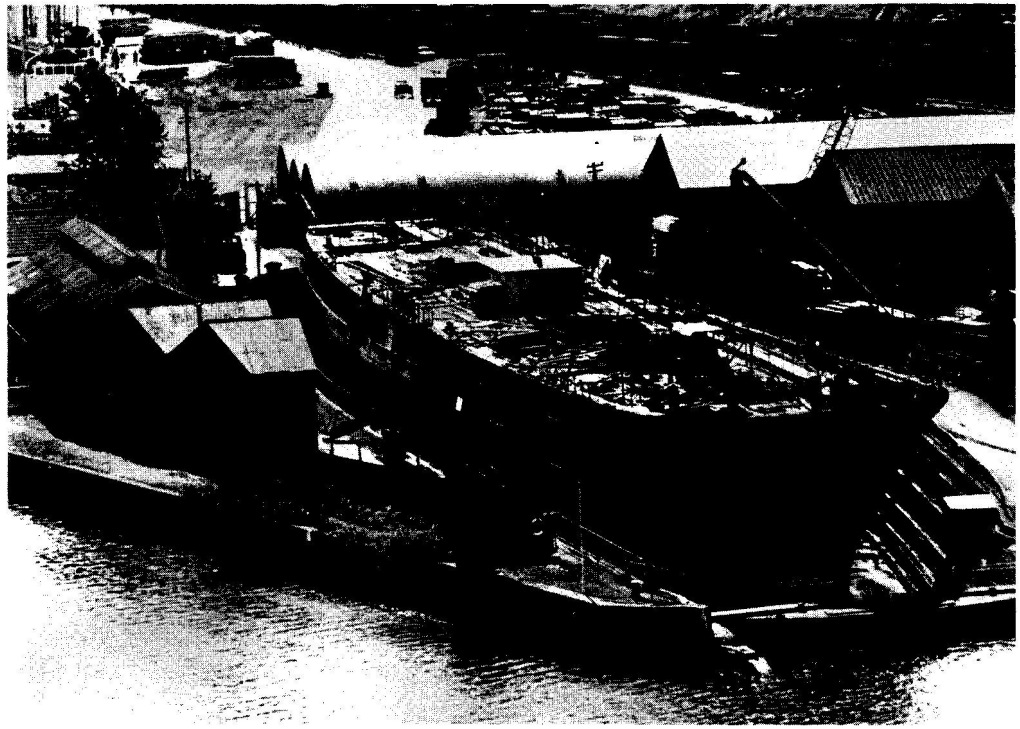
further checks on the fastenings between the ship and the pontoon, and arrived in Barry Roads off the Welsh coast on the sunny evening of June 22nd. Here Captain Herzog and *Varius II* handed over to Bristol tugs, and the following morning, Tuesday June 23rd, 1970, the *Great Britain*, still on her pontoon, was brought into Avonmouth Docks to be greeted with a salute from every ship's hooter in the port and enormous interest throughout the nation.

She was taken off the pontoon in Avonmouth graving dock and towed up the River Avon to Bristol, afloat on her own bottom, on July 5th. A hundred thousand people lined the banks to see her. For two weeks she lay afloat, tied up at Y Wharf in Bristol City Docks, waiting for a high



The Great Britain *passing beneath the Clifton Suspension Bridge, also a Brunel design, July 5th, 1970*

The ship being eased into the Great Western Dock, Bristol. July 19th, 1970



The ship in Great Western Dock, 1970

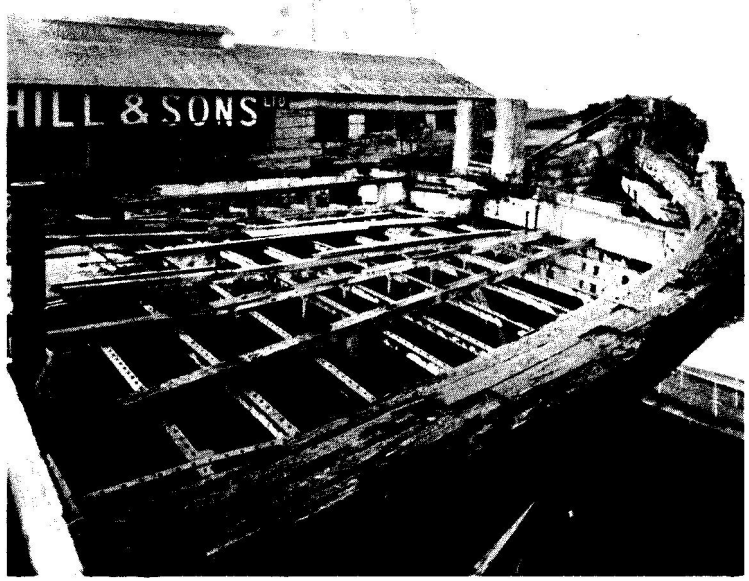
enough spring tide to get her through the shallow and narrow entrance to the Great Western drydock, where she now lies. By pure and extraordinary coincidence the first date for this was July 19th—the anniversary of her first plates being laid there in 1839 and of her launch there in 1843. And by another series of extraordinary chances that Sunday evening also proved to be the only possible moment when the Duke of Edinburgh could be present at short notice. Thus Prince Albert, the Prince Consort, had launched the *Great Britain*, and Prince Philip was actually on board for the re-docking, the ship's first and only return after exactly 127 years. It was a legendary homecoming.

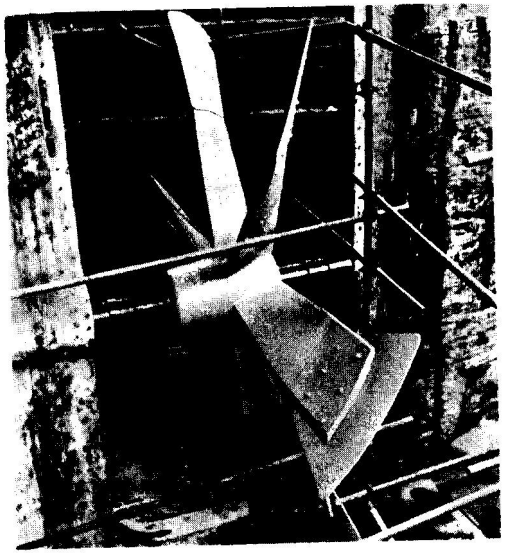
Restoration

Since that summer evening in 1970 a good start has been made with restoration and it is already possible for visitors to picture quite readily what the finished ship will look like. The basic intention, decided at the outset of the work, is to restore the full external appearance of the original Brunel ship of the 1840's, together with a limited amount of the interior, but enough to show what life on board was like. In the main this will consist of the after promenade deck and dining saloon, with one representative set of cabins; the crew's quarters in the forecastle; and the engine room, with its four large cylinders, high level crankshaft, and the driving chain down to the propeller shaft below. There will be a reconstruction of the after boiler face, and it is hoped to be able to turn the engine with an electric motor.

For those in charge of the Project during these years the problems have been as varied as they have been constant. The first need had been a great deal of research into the basic design and construction of the ship. Once home, the intention was to preserve as much as possible of the existing hull. This required detailed examination of the structure in order to identify original material, before drawings and specifications could be prepared for restoration. It meant concentrating the limited financial resources, particularly during the first three years, on getting back to the basic Brunel hull. This involved removing 10,000 bolts and the heavy wooden cladding of 1882, taking off the blanking plates on all the portholes, and uncovering the early hawsepipe. A high proportion of the rest of the effort was inevitably concentrated on simply removing rust and scale from the ironwork. This was done with very high pressure water jetting, followed by flame-drying and painting. Circumstances also demanded a decision to use modern materials for economy and durability,

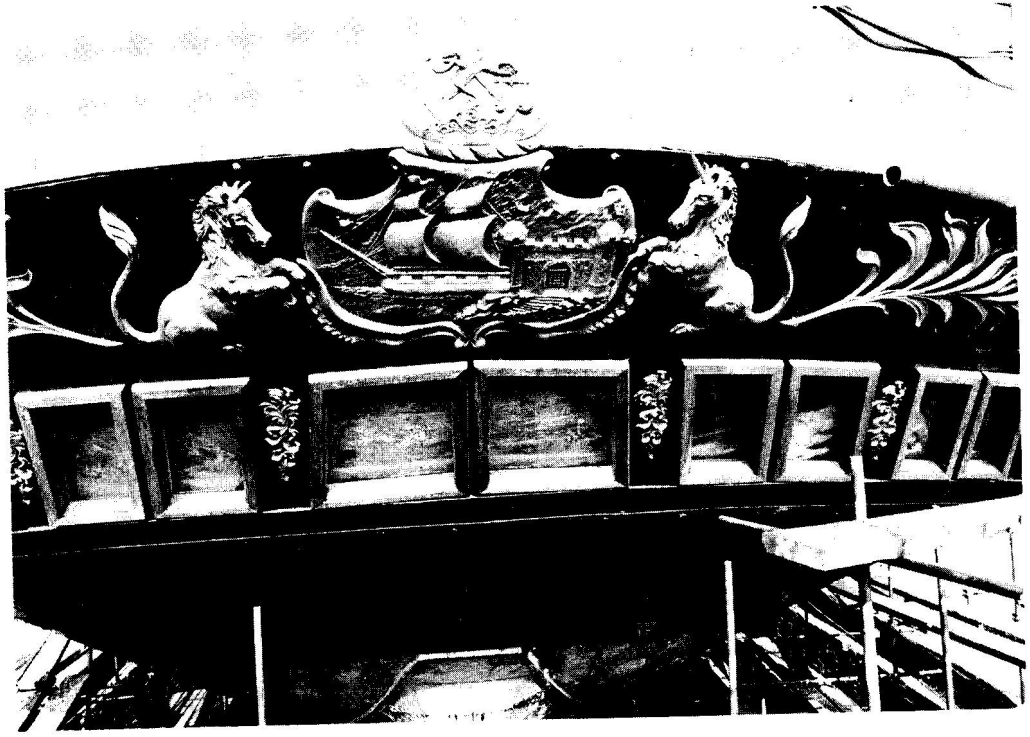
Left: Cleaning the hull with water using high pressure hose
Right: The Forecastle deck before restoration

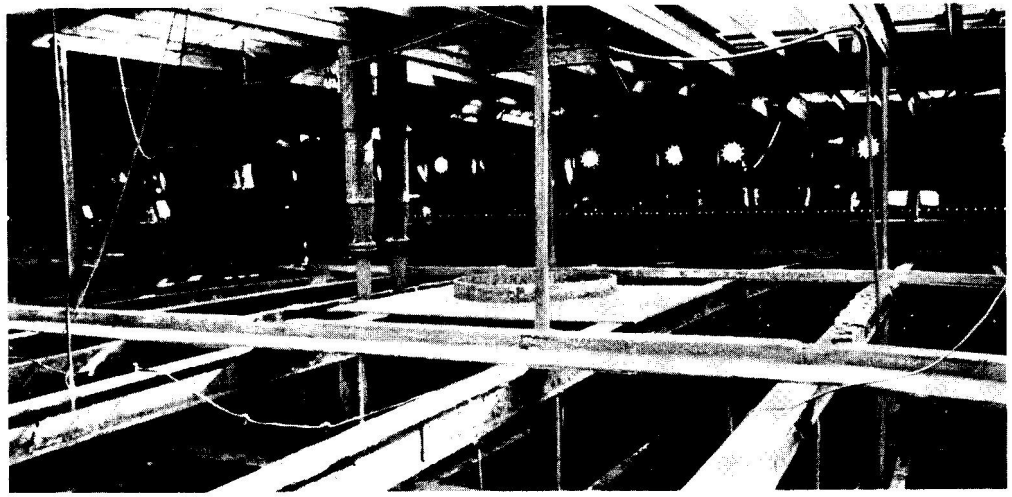




Left: The reproduction 1843 propeller mounted temporarily in the 1857 stern frame

Below: The stern with new windows and decorations including the coat-of-arms of the city of Bristol





Looking aft from the starboard side; the portholes are now clearly visible

this would not only reduce the extent of necessary underwater restoration, since she would not be required to float again, but it would in itself constitute a unique world exhibit—this historic first propeller-driven ship in the actual dock built for her construction. The drydock, which had been leased to Charles Hill and Sons, belongs to the city. And on January 23rd, 1975, a formal decision was taken by the City Council to lease it at a peppercorn rent direct to the Project, with a view to the *Great Britain* staying there permanently.

It had always been a curious chance that in the very period when the *Great Britain* happened to have been salvaged after a century and a quarter, technical and economic developments had led to the closing down of Bristol City Docks to ordinary commercial traffic. But the City Council's decision was momentous in itself both for Bristol and for the *Great Britain*. Received with deep gratitude by the Project, it meant that long term plans could now be made for the ship's future and for her ultimate surroundings as a public exhibition. Already visited by over 100,000 people a year, the *Great Britain*, gradually restored to her original image, would become in the same moment an asset to Bristol and an exceptional national treasure.

Left: View of the ship in 1975 showing the funnel and restoration progress
Front cover: s.s. *Great Britain* 1845
Back cover: *Great Britain* awaiting salvage in Sparrow Cove, Falkland Islands, 1970

Picture Acknowledgements
Bristol City Museum p 6; BTR Industries p27; Lt. Colonel K. M. C. Mallam p 18; National Maritime Museum, Greenwich pp 2, 5, 8–9, 11, 17; Port of Bristol Authority p 24; Press Association p 26; Radio Times Hulton Picture Library pp 7, 15; San Francisco Maritime Museum pp 20, 23. All other material was supplied by the s.s. *Great Britain* Project

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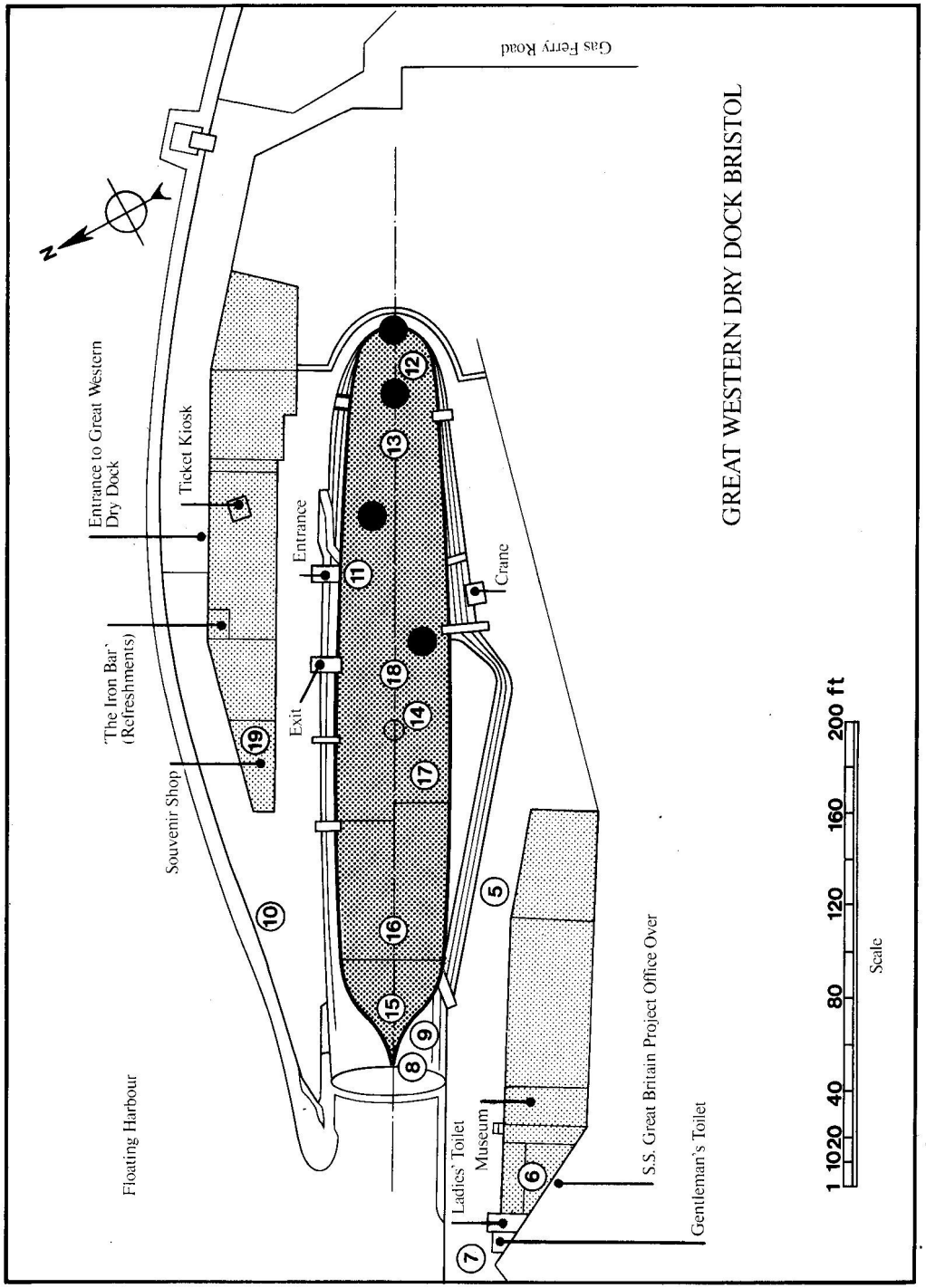

OFFICIAL GUIDE

At any time it may be necessary to close part of the public route round the dock or aboard ship due to work in progress.

Introduction

Launched in 1843 as an Atlantic liner, the s.s. *Great Britain* was the first ship built of iron and driven by a propeller to cross to America. During her long life she was altered in many major ways, ending her career as a sailing cargo ship. Her seagoing life terminated in the Falkland islands in 1886 whence she was salvaged and brought back in 1970 to the very dock in which she was built.

The aim of the restoration programme is to restore the ship to its original appearance of 1843, but pending completion, the visitor will inevitably see portions of later alterations and additions.

The recommended route around the dock and ship is indicated by red arrows, while a diagram on the back of this leaflet has reference numbers indicating the position of certain items referred to in the text which follows.

Keel and Stern arrangements

On the dock bottom the keel of the ship and the bottom plating can be closely inspected. Most of the iron plates are about 6 × 3 feet and are thicker below the waterline. They are overlapped horizontally and connected by two rows of iron rivets. Vertically the plates are butted together and connected on the inside by iron butt straps (1).

A new propeller, following as closely as possible the design of the original of 1843 conceived by Brunel, has been installed temporarily in the 1857 stern frame (2). The latter was added to the ship to enable a lifting-type propeller to be operated during the long voyages to Australia and will be removed as restoration proceeds.

Looking up from the dock bottom, observe the windows and gilded decorations at the stern which you can study more closely from the dockside walk later if you wish (3).

Proceeding along the Port side, inspect one of the docking or auxiliary keels which support the ship on either side of the main keel (4).

Dockside Displays

Returning to the top of the dock, you can obtain a good view of the whole length of the ship and its painting scheme which includes a row of imitation gun ports. You can also study a display panel which gives current information about restoration (5). Further on to your left is our small museum where many relics of the ship are on display (6).

Lying outside the museum on the harbour edge is the huge mast which served as the ship's mainmast from 1857 (7).

The Bows

At the top of the stem is the figurehead which is the coat-of-arms of Great Britain (8). Behind on either side are decorative trailboards with symbolic motifs. Surmounting the stem the 42-foot bowsprit stretches out over the dock gate.

Abreast the bow lies one of the ship's Trotman designed anchors. Originally the anchor chain emerged from the lower hawsepipe in the stem but later in the ship's life the upper hawsepipes were added and the lower sealed (9).

As you cross in front of the ship, note the very beautiful hull form built for speed like a clipper ship.

Passing down the Starboard side have a look at the huge yardarm which was fitted to the mainmast in 1857 (10). There is no record of a longer one ever being made.

The Promenade deck and Stern gallery

You enter the ship by an original passenger embarkation door cut in 1855 (11) at the level of the promenade deck. Originally there was a central promenade from the engine-room bulkhead to the stern gallery (12) with blocks of cabins on either side.

Mounting the stairway to the weatherdeck, you can observe the progress of restoration and look aft to see the circular skylight on the poop (13).

The Funnel and Weatherdeck

Proceeding along the weatherdeck walkway you become aware of the length of the vessel (322 feet) and the area of open deck. The funnel, which is a reproduction of the original in steel, towers 38 feet above the deck level (14), but this is easily topped by the mainmast standing 74 feet above the deck.

The Forecastle and Windlass

At the forward end of the walkway you can see the restored forecastle deck with its companionways, the bowsprit and supporting pillars called bitts (15). To your right is the hand-operated windlass which pulled in the iron cable (16).

The Ship's Bell

Passing below to the temporary platform at the upper 'tween deck level you can inspect the ship's plating which has been patched with glass-reinforced plastic and the ship's bell temporarily suspended from the deck beams (17).

The Centre Hold

A stairway takes you down into the centre hold, the whole of which was originally occupied by the engine and boilers. The four vast cylinders of the engine rested close against the ship's side plating on either side of the compartment while the flywheel protruded nearly 3 feet beyond the level of the weatherdeck above your head (18).

Conclusion

On leaving the ship you may wish to purchase a souvenir of your visit in our shop (19) or have a second look around the museum.